

MAR - 3 2009

SP-14820N  
Attachment 1

PHM5A-2009-00106  
DOT TRANSPORTATION  
DOCS

**Special Permit Application**  
**Shipment of Boron Trifluoride Neutron Detection Equipment**

**Background**

Pacific Northwest National Laboratory (PNNL) has used a variety of boron trifluoride (BF<sub>3</sub>) neutron detector tubes in reactor and security application research and is in the process of excessing many of these tubes. Idaho State University in Boise, Idaho, has expressed interest in receiving detectors for purposes of research and training.

In accordance with 49 CFR 172.101, boron trifluoride is a Hazard Class 2, Division 2.3 material (gas poisonous by inhalation), which must be packaged in specification cylinders as described in 49 CFR 173.302, "Filling of cylinders with non-liquefied (permanent) compressed gases." Most of the neutron detector tubes are being transported in accordance with DOT-SP 8748 (Revision 10).

PNNL has fifty-four (54) neutron detector tubes manufactured by the Harshaw Chemical Company (model # B4-72S) which cannot be shipped under DOT-SP 8748 since the permit is specific to Reuter Stokes tubes. The Harshaw tubes are 6-in. in diameter and 72-in.-long (active length), maintained at an absolute pressure of 50 cm Hg (9.7 psia). The Harshaw Chemical Company no longer exists.

The U.S. Department of Energy (DOE) is requesting a special permit on behalf of PNNL to ship the Harshaw tubes. Packaging for the Harshaw tubes is available which will meet the same standards required by DOT-SP 8748. The following special permit application has been prepared in accordance with 49 CFR 107.105, "Application for special permit."

**49 CFR 107.105 Application for special permit.**

**(a) General. Each application for a special permit or modification of a special permit must be written in English and must—**

- (1) Be submitted for timely consideration, at least 120 days before the requested effective date, in duplicate**
- (2) State the name, street and mailing addresses, e-mail address optional, and telephone number of the applicant; if the applicant is not an individual, state the name, street and mailing addresses, e-mail address optional, and telephone number of an individual designated as an agent of the applicant for all purposes related to the application;**

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(509) 371-7904

*(3) If the applicant is not a resident of the United States, a designation of agent for service in accordance with Sec. 105.40 of this part; and*

N/A

*(4) For a manufacturing special permit, a statement of the name and street address of each facility where manufacturing under the special permit will occur.*

N/A

*(b) Confidential treatment. To request confidential treatment for information contained in the application, the applicant shall comply with Sec. 105.30(a).*

N/A

*(c) Description of special permit proposal. The application must include the following information that is relevant to the special permit proposal:*

*(1) A citation of the specific regulation from which the applicant seeks relief;*

This special permit application is made because the non-DOT-specification cylinders, which contain the gas, are not authorized. The regulatory citation from which relief is requested is as follows:

Title 49, *Code of Federal Regulations* (49 CFR), Part 172.101,  
Column 8B (non-bulk packaging) as applicable to boron trifluoride;  
173.302, "Filling of cylinders with non-liquefied (permanent)  
compressed gases."

*(2) Specification of the proposed mode or modes of transportation;*

Transport will be solely by motor vehicle/public highway. One-way shipment(s) will occur from the PNNL, Richland, Washington to Idaho State University in Boise, Idaho. If possible, all fifty-four (54) tubes will be shipped on a single conveyance.

- (3) A detailed description of the proposed special permit (e.g., alternative packaging, test, procedure or activity) including, as appropriate, written descriptions, drawings, flow charts, plans and other supporting documents;*

PNNL proposes to rely on the existing neutron detector (instrument) containment system, designed to contain the gas, as the primary packaging for transportation. A strong outside packaging, consistent with that used for DOT-SP 8748, will be used to protect the primary containment. Attached is a detailed design analysis for the external packaging.

- (4) A specification of the proposed duration or schedule of events for which the special permit is sought;*

This special permit is being requested for one-way shipment of fifty-four (54) neutron detector tubes in four packages (on one conveyance, if possible) to be completed within 12 months following issuance of the special permit. This duration includes planning, carrier scheduling, and transporting to the destination facility.

- (5) A statement outlining the applicant's basis for seeking relief from compliance with the specified regulations and, if the special permit is requested for a fixed period, a description of how compliance will be achieved at the end of that period;*

49 CFR 173.302 requires that boron trifluoride be shipped in specification cylinders. The regulations did not specifically anticipate the shipment of boron trifluoride as components of radiation detection instruments. The welded neutron detector tubes were successfully transported to the Hanford Site in the 1960s (previous shipping records could not be located) and performed as required in service. PNNL believes the neutron detector tubes, properly protected and secured using high-density foam spacers, within stout wooden crates provide adequate containment and packaging of the boron trifluoride for this one-way shipment. Paragraph (8), below, further describes the packaging system proposed, as the basis for regulatory relief. No further packages are anticipated for shipment once this 54 tube campaign is complete.

- (6) If the applicant seeks emergency processing specified in Sec. 107.117, a statement of supporting facts and reasons;*

NA

- (7) Identification and description of the hazardous materials planned for transportation under the special permit;*

The hazardous material offered for transportation is nonradioactive boron trifluoride, Hazard Class 2.3, UN1008. The gas is contained under an absolute pressure of 50 cm Hg (0.66 atm). The hazardous material is a gas over the range of temperatures expected during transport. The fifty-four (54) neutron detector tubes are estimated to contain 58.3g of boron trifluoride each.

- (8) Description of each packaging, including specification or special permit number, as applicable, to be used in conjunction with the requested special permit;**

Figure 1 shows typical markings on one of the tubes serving as the primary containment. Figures 2 and 3 show end and side views of the tubes and the boxes proposed for transport. All 54 of the tubes were manufactured by the Harshaw Chemical Company (Cleveland, Ohio) in the 1960s. No design data or vendor records for the tubes were located in the Hanford archives or from the organizations that bought the various divisions of the former Harshaw Chemical Company.

The Type B4-72S neutron detector tubes providing containment of the hazardous materials are constructed of an estimated 26 gauge (0.01875-in. thick) stainless steel surrounded by an estimated 28 gauge (0.0157-in. thick) shroud/radial stiffener providing structural reinforcement. The tubes have overall lengths of 82.5-in. (without electronics) or approximately 84-in. (with electronics or foam), and a 6-in. external diameter (including 2-in.-wide radial stiffeners). The 2-in.-wide radial stiffeners are centered roughly 4-in. apart along the entire length of the tube. Fill pressure is 50 cm Hg (about 0.66 atm). The non DOT-specification pressure envelope has welded or soldered joints, and braised ceramic to metal insulator feed-through assemblies. The tubes weigh between 14 lb and 17 lb each, depending on the electronics attached to the tube. All 54 tubes are in good condition and show no signs of corrosion.

A screwed-on sleeve intended to protect instrumentation was removed from some tubes. New protective foam end caps will be secured to these tubes. Foam shall be sufficient to protect the valve from impact or breakage in the event of a 7-ft drop onto a non-yielding surface at an orientation most likely to cause damage. Figure 4 shows a sketch of the tubes including the foam end caps (the 4.5-in. extension in Detail A and the 3.4-in. extension in Detail B).

Tubes will be secured in each of four nominal 2-ft-tall, 4-ft-wide, 8-ft-long wooden crate constructed of 23/32-in.-thick AC fire-rated plywood on a dimensional-lumber (2x4) frame secured with glue and staples. The lid will be secured to the box with epoxy and 1½-in. deck screws every 3 inches. Two steel bands are secured around the perimeter of the box and six steel bands will be secured over and under (perpendicular to the long axis of) the box. Four 4x4 skids attached to the bottom of the box facilitate access for forklift handling. Figures 5 and 6 show the proposed strong outside packaging arrangement.

Within the box, up to 14 tubes will be secured and protected using fabricated high-density, rigid polyethylene foam (Stratocell H or equivalent) slabs, saddles, and end caps. Figure 4 shows the foam end caps. Figure 6 shows the foam slab/saddle arrangement.

Placarding, marking and labeling will be in full compliance with DOT. The carrier to be used for the one-way shipment will be fully qualified and licensed to haul hazardous materials of this description.

- (9) For alternative packaging, documentation of quality assurance controls, package design, manufacture, performance test criteria, in-service performance and service-life limitations.*

N/A

- (10) When a Class 1 material is forbidden for transportation by aircraft except under a special permit (see Columns 9A and 9B in the table in 49 CFR 172.101), an applicant for a special permit to transport such Class 1 material on passenger-carrying or cargo-only aircraft with a maximum certificated takeoff weight of less than 12,500 pounds must certify that no person within the categories listed in 18 U.S.C. 842(i) will participate in the transportation of the Class 1 material.*

N/A

- (d) Justification of special permit proposal. The application must demonstrate that a special permit achieves a level of safety at least equal to that required by regulation, or if a required safety level does not exist, is consistent with the public interest. At a minimum, the application must provide the following:*

- (1) Information describing all relevant shipping and incident experience of which the applicant is aware that relates to the application;*

This is a new special permit application so there is no incident experience with this special permit. PNNL is not aware of any transportation incidents relevant to similar neutron detector tubes. No commercial transportation history was located including the original shipment to the Hanford Site. All shipments on the Hanford Site have occurred without incident. Leaks did occur from two damaged (bent) tubes during handling over the life of the tubes (not transportation) but those tubes are not among those to be shipped under the special permit; none of the tubes to be transported are damaged.

DOT-SP 8239, DOT-SP 8748, DOT-SP 12087, and DOT-SP 14477 have been used in the past by both government and commercial entities to ship boron trifluoride tubes of similar design. PNNL has Party status for DOT-SP 8748, which authorizes shipment of

2-in.-diameter Reuter Stokes boron trifluoride tubes of a similar age; there are no known incidents relevant to shipment of those tubes.

- (2) A statement identifying any increased risk to safety or property that may result if the special permit is granted, and a description of the measures to be taken to address that risk; and*

PNNL believes there is no increased risk to public safety or property given the packaging controls proposed in this special permit application. The proposed packaging system provides substantial protection of the tubes during the one-way shipment.

- (3) Either:*

- (i) Substantiation, with applicable analyses, data or test results, that the proposed alternative will achieve a level of safety that is at least equal to that required by the regulation from which the special permit is sought; or*
- (ii) If the regulations do not establish a level of safety, an analysis that identifies each hazard, potential failure mode and the probability of its occurrence, and how the risks associated with each hazard and failure mode are controlled for the duration of an activity or life-cycle of a packaging.*

FSWO-ECAL-353, *BF3 Tube and Transport Box Evaluation* (Attachment B), demonstrates that during drop, stack and vibration tests, the box will maintain confinement of the tubes and that the tubes will not be damaged; Section 3.0 of the evaluation presents the results and conclusions.

Figure 1. Markings on Harshaw Neutron Detector Tubes.

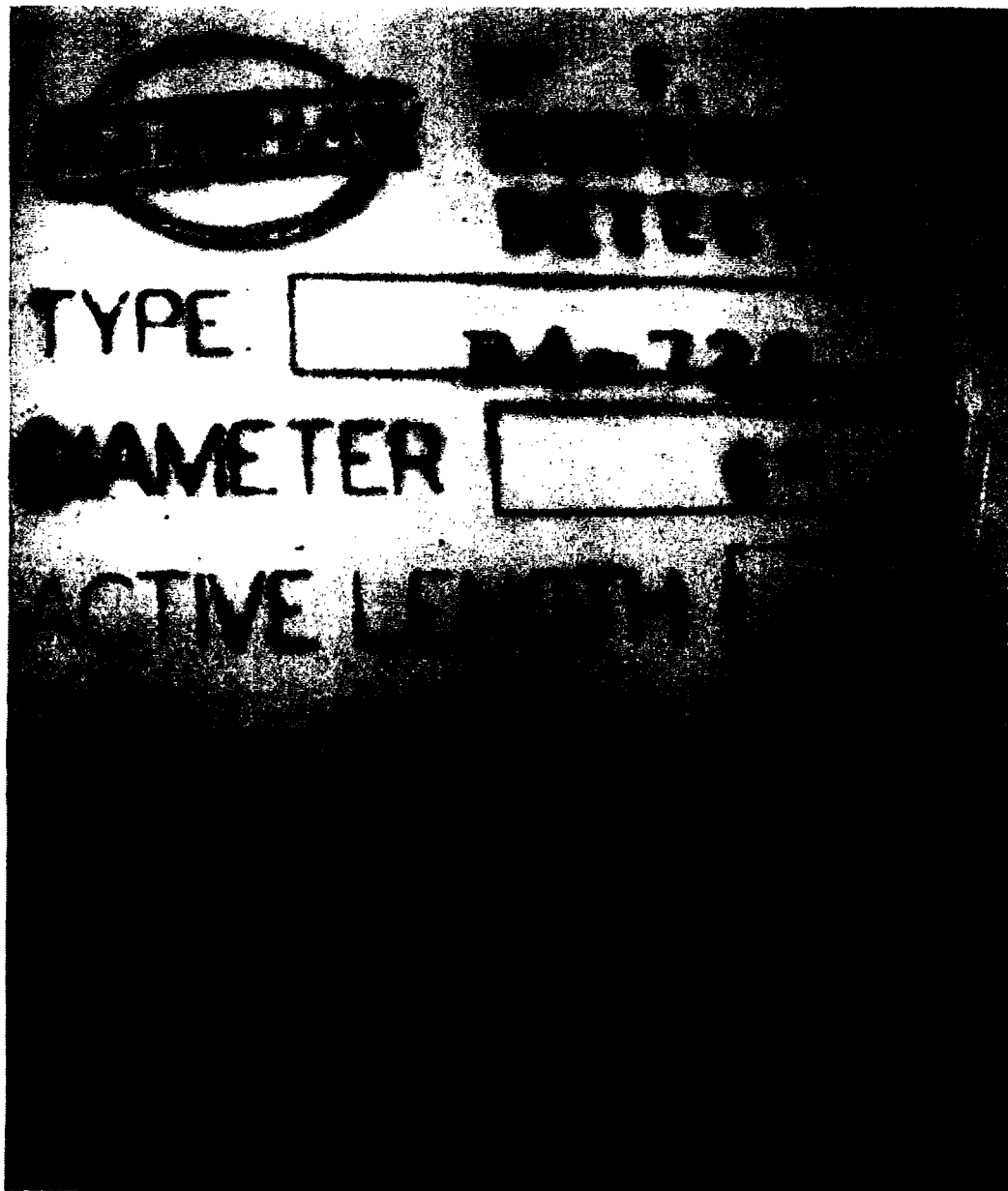


Figure 2. End View of Harshaw Neutron Detector Tubes.

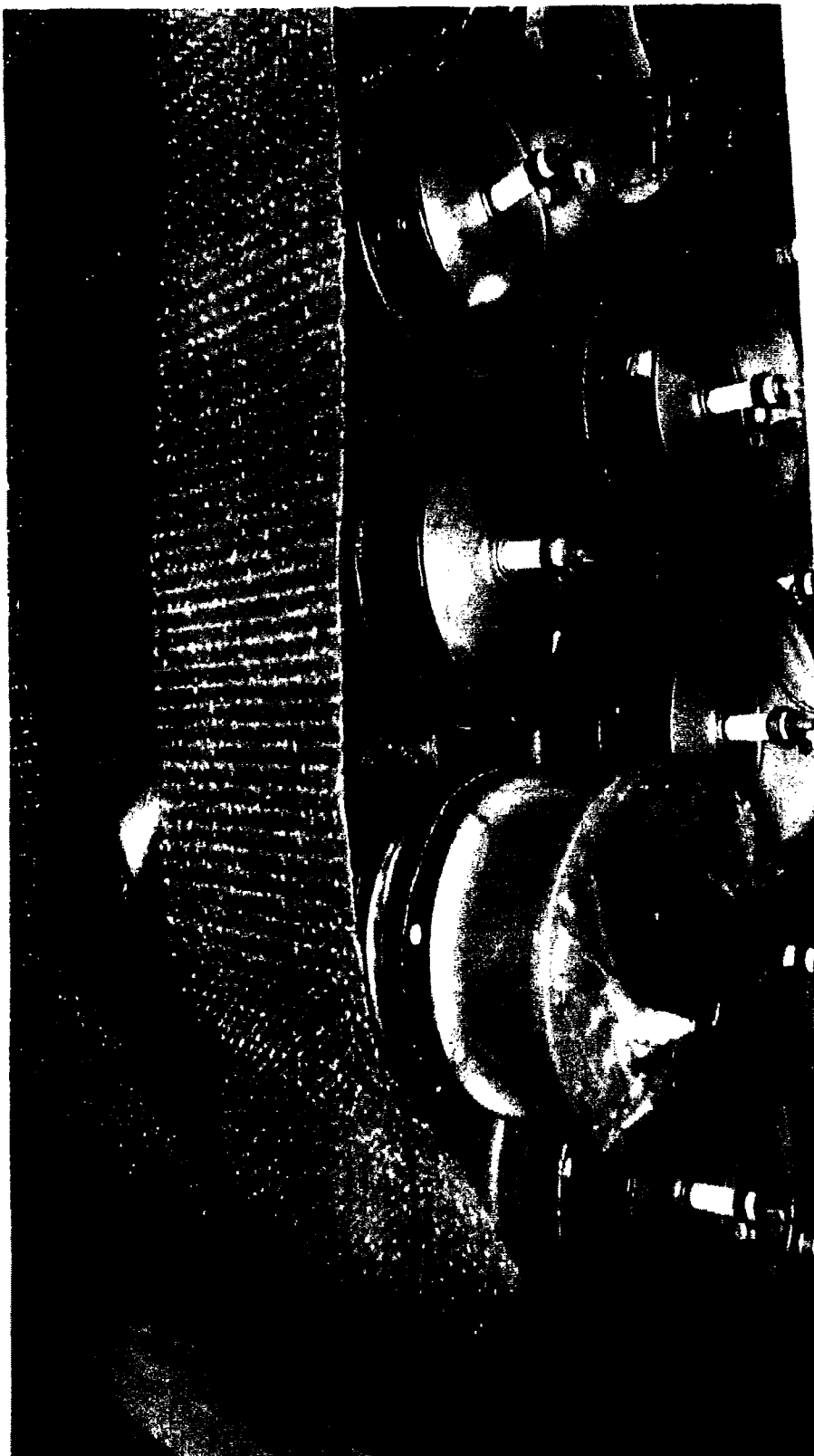




Figure 3. Side View of Harshaw Neutron Detector Tubes.



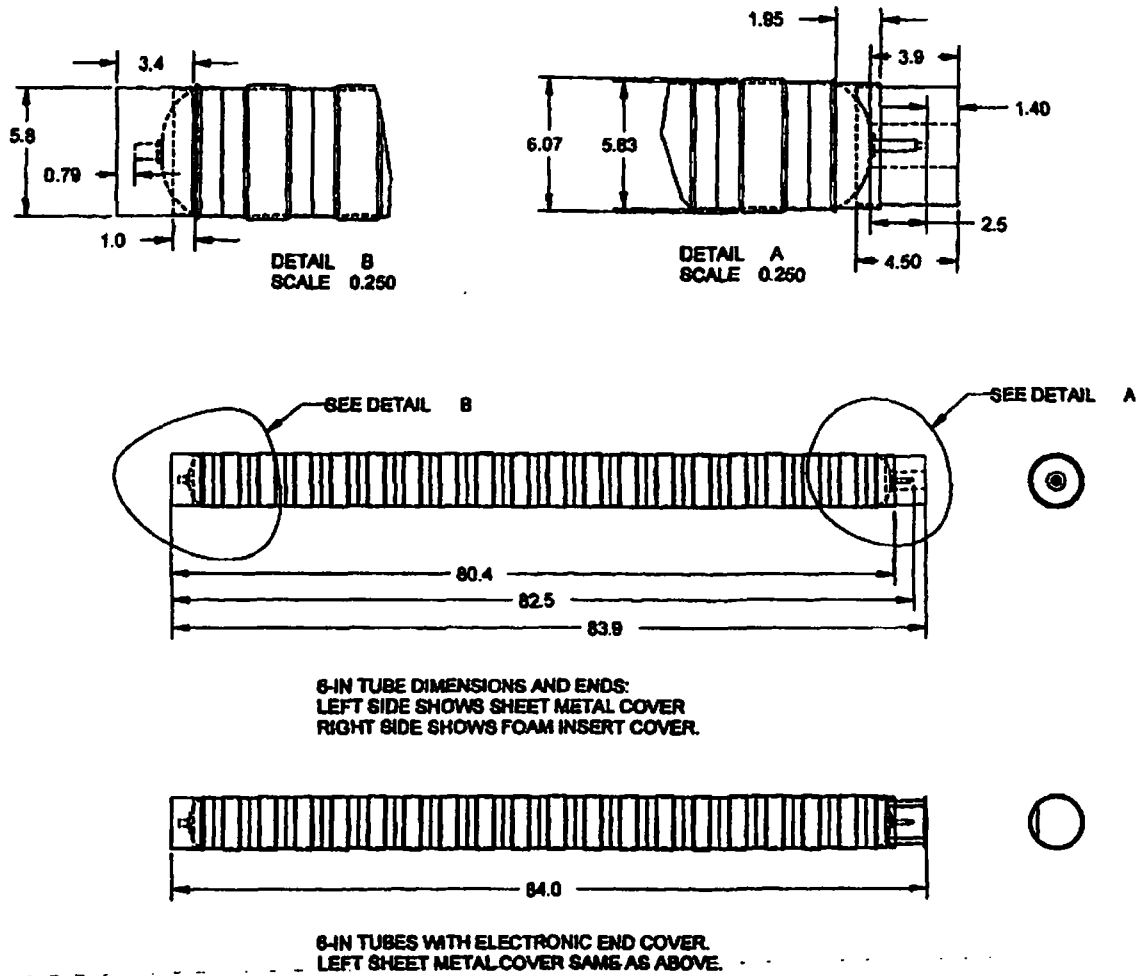
Figure 4. BF<sub>3</sub> 6-in Tube End Covers (sketch).

Figure 5. BF<sub>3</sub> Plywood Box Assembly and Dimensions.

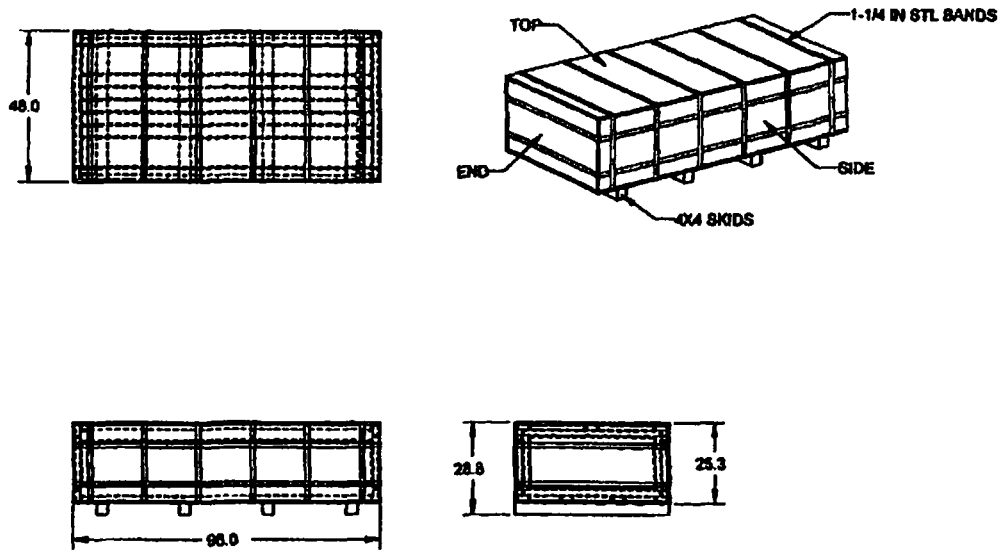


Figure 6. Isometric View of Box with Harshaw Tubes.

